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Strategy for palaeoclimate time-series analysis using constraints from climate simulators

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One general objective of the palaeoclimate scientist is to extract information about climate dynamics from palaeoclimate evidences, which are by nature sparse, indirect, and bear dating uncertainties. Climate simulators do provide constraints on how climate may plausibly behave and respond to external forcings. The problem, though, is that the amount of information they generate seems overwhelming compared to palaeoclimate data. Here, we consider a strategy where a statistical dynamical system is used to combine information from simulators and data in order to enhance dynamical understanding and provide probabilistic predictions. The flow of information from simulators to the dynamical system involves a process of empirical reduction of dimensionality, while palaeoclimate data information is taken into account through a process of Bayesian calibration and model selection, using a particle filtre.

This programme implies a number of technical challenges such as statistical calibration of non-autonomous dynamical systems, and stochastic calibration of time-uncertain data. The case will be illustrated based on 800-kyr long simulations with the LLN-2D climate-ice sheet model. The latter was chosen because it has a low computational cost by today's standards, but yet is complex enough to make the exercise non-trivial.